NORTH CAROLINA
Department of Transportation









Excavation & Trenching

Trench/Excavation Worker Safety

Why Excavation Safety?

- Related to your job (hazard/risk assessment);
- Necessary for your protection and the protection of others from injury while on the job (exposure);
- Working safely is a condition of employment
- Protect from criminal charges, a civil lawsuit, or an OSHA citation;
- In 1990 the DOT had a cave-in fatality in Iredell County. We do not want anymore fatalities.
- In 2015 the DOT had a cave-in that injured 2 workers.

Course Objectives

- Terminal objective: The student will be able to recognize and avoid hazards associated with excavations.
- Enabling objectives:
  - Identify hazards associated with excavations.
  - Describe the methods for protecting employees.
  - Describe the role of a competent person at an excavation site.
  - Apply excavation hazard protection methods.

Why Excavation Safety?

- Federal law mandates that all workers have a safe place to work.
- OSHA Regulation – 29 CFR 1926.650
- NCDOT - Safety Policy and Procedure 1926.650
  - This safety policy and procedure is established in accordance with Occupational Safety and Health Standards for Construction Industry 29 CFR 1926.650.

- NCDOT – Workplace Safety Manual SOP 11E-3

What are the Dangers?

- Two workers are killed every month in trench collapses.
  - What is the single most dangerous hazard associated with excavations?

CAVE-INS

  - What are other potential hazards associated with excavations?
    - **Falls**
    - **Falling Loads**
    - **Hazardous Atmospheres**
    - **Incidents involving mobile equipment (backhoes, excavators)**
    - **Struck By**


Oregon OSHA
Excavation
Inspection
Tim Marcum,
Compliance Officer

Excavation Definitions

- Excavation - Any man made cut cavity, trench or depression in an earth surface, formed by earth removal.
- Trench - A narrow excavation, the depth is greater than the width, but the width of a trench (measured at its bottom) is not greater than 15 feet.

Excavation Definitions

- Spoil Pile – excavated materials, topsoil, rocks, etc., temporarily stored beside excavation.
- Surcharge Load – the weight of spoils or equipment exerting pressure on the surface of the soil near an excavation.
- Registered Professional Engineer (RPE) – a person who is registered in the state where work is to be performed.

Excavation Definitions

- Competent Person - one who:
  - Can identify existing or predictable hazards in an excavation,
  - Has the authority to take corrective actions as necessary,
  - Is familiar with the excavation standards,
  - Is knowledgeable in soil analysis and classification as well as the erection, use, and precautions for the protective system on site.

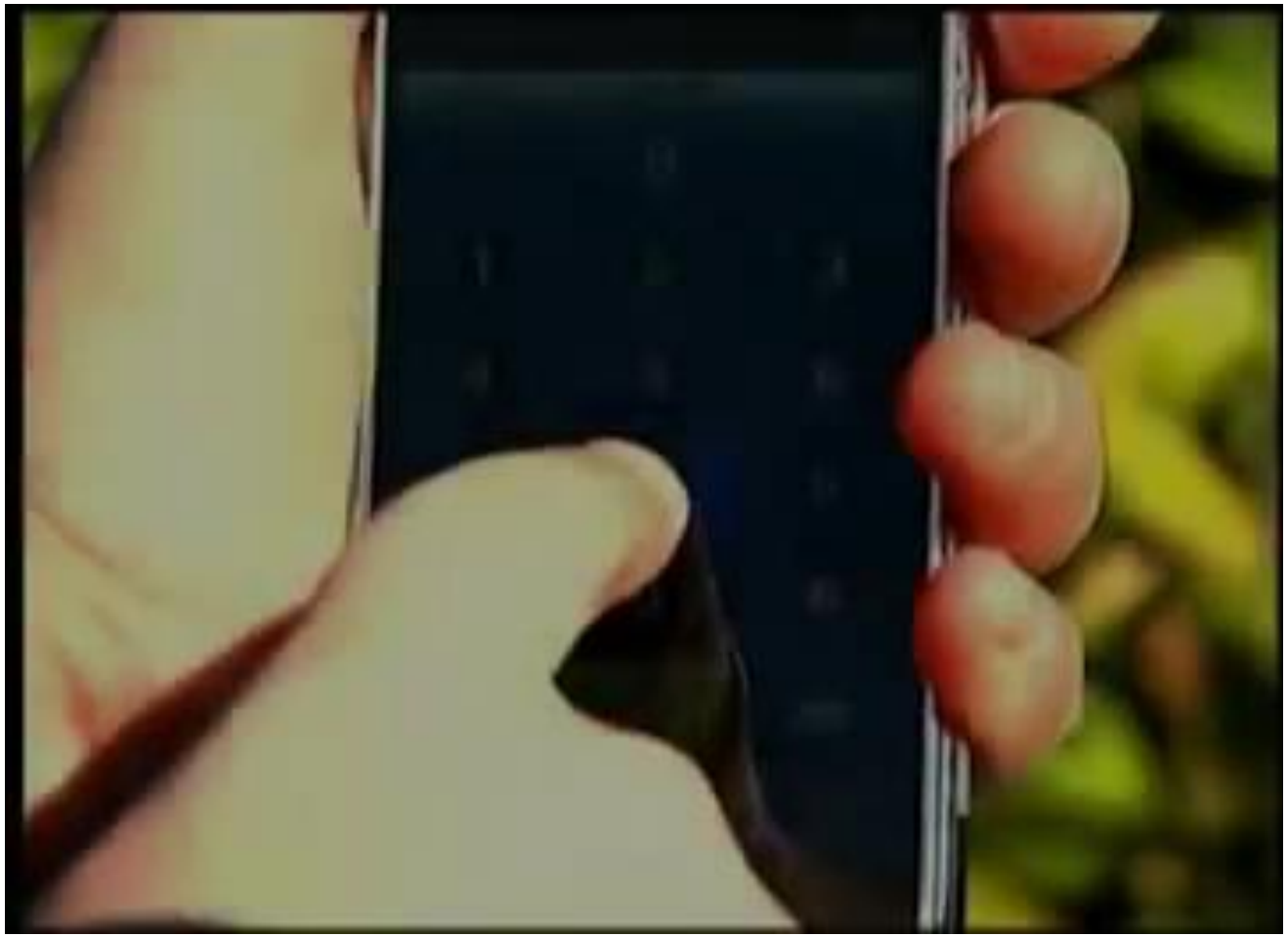
Competent Person

- OSHA says that, "… for the purposes of this standard, one must have had specific training in and be knowledgeable about:
  - soils analysis
  - the use of protective systems
  - the requirements of the standard
- One who does not have such training or knowledge cannot possibly be capable of recognizing existing and predictable hazards in excavation work or taking prompt corrective measures."

NC Utility Location Service

- Dial 811 more than 72 hours prior to excavation
- Answer a series of questions to pinpoint dig location
- Document 811 ticket number
- NC law requires a three full working days notice to utility owners
- That begins the first day “after” dialing 811
- Weekend and holidays are not counted

Video NC 811



Required information for a locate request

North Carolina 811 – www.nc811.org

Phone number:_____ Company Name:_____

Caller's Name (First & Last):_____

Company's address:_____ City:_____

County of excavation:_____ City/Town of excavation:_____

Subdivision or business name where excavation is being done:_____

Street address to be located:_____

Is the entire work being done at the intersection? (circle one) YES NO

If No, then how far from the intersection? (Please circle one) Less than ¼ mile ½ mile ¼ mile 1 mile

Locate directions:_____

_____

_____

Blasting/Use of dynomite? (circle one) YES NO

Boring (horizontal under the road or driveway? (circle one) YES NO

Railroad tracks within ¼ mile? (circle one) YES NO

Scheduled work date: ___/___/___

What type of work is being done?_____

Whom is the work being done for?_____

Site contact name: _____ Phone number:_____

Special note or remarks:_____

_____

_____

_____

_____

Ticket number from NC811: _____

Utilities that NC811 notified:_____

_____

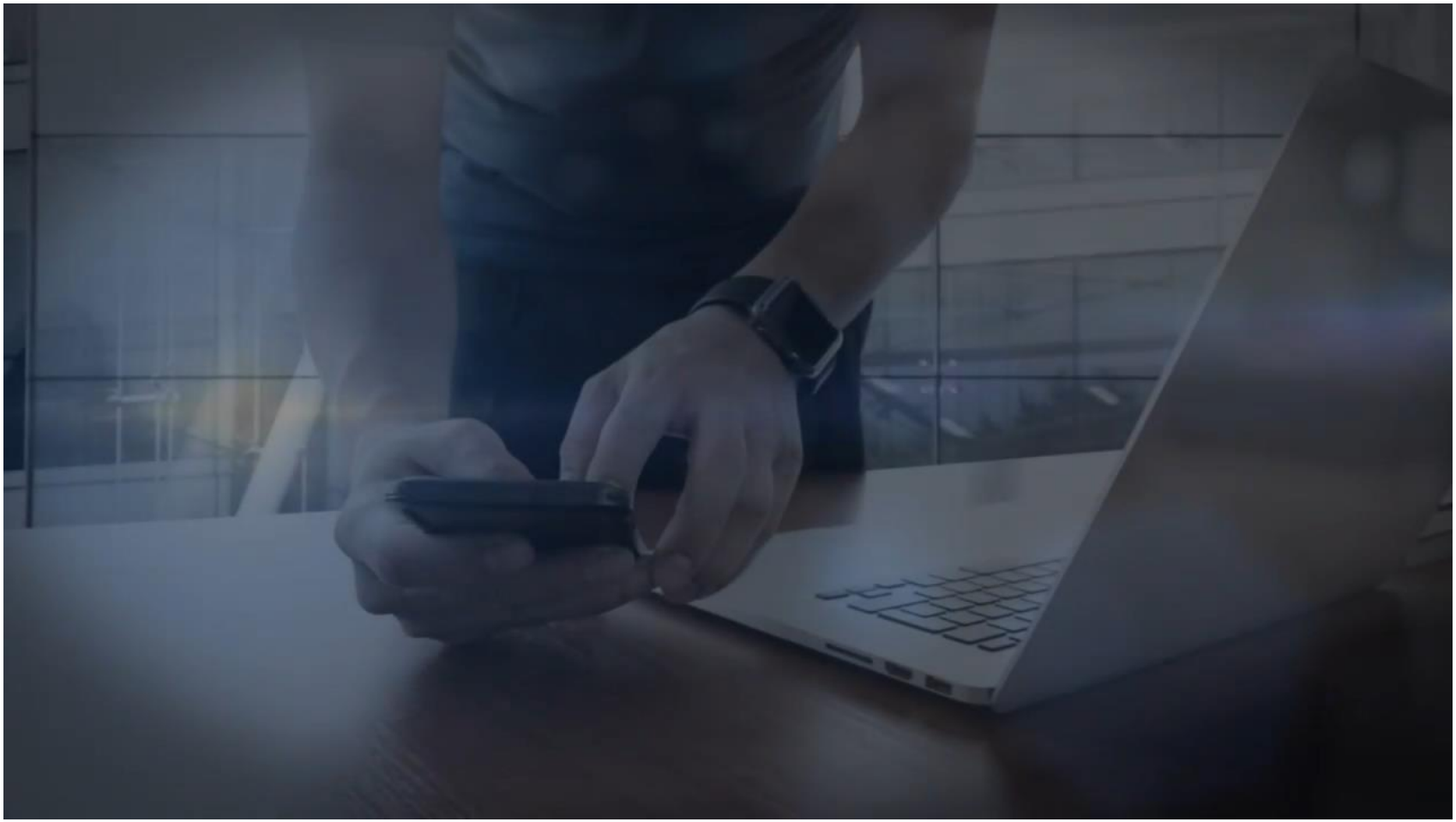
_____

This sheet is for informational purposes only. Please contact 811 directly by dialing 8-1-1 to put in a locate request. Requests will not be accepted by mail or email.

NC Utility Location Service

- Document list of utility companies notified by NC 811
- Every utility company is not a member of NC 811
- Contact utility providers that are not members of NC 811

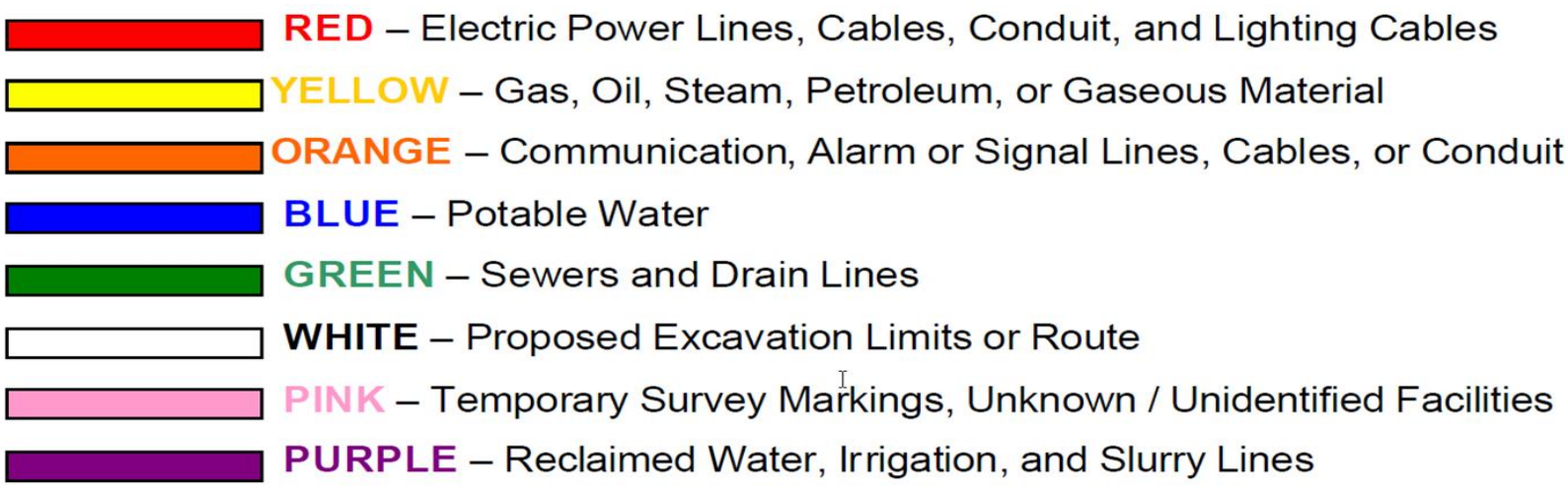
North Carolina 811 App



Utility Location Video

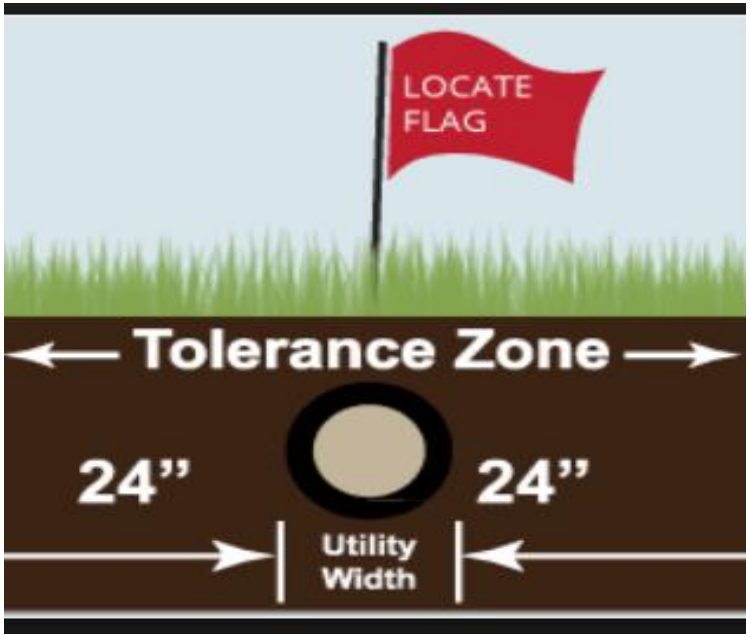
NC 811 Utility Location Markings

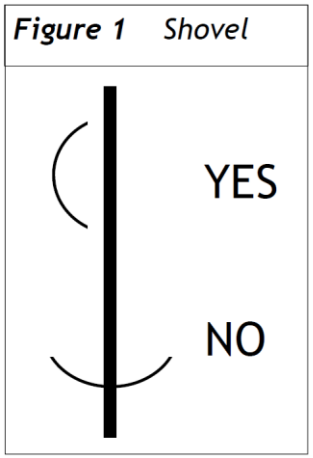
- Verify NC 811 has responded and marked as requested
- Verify that NC 811 non-member utility owners have marked utilities
- Underground facilities will be marked by color coded paint, stakes or flags APWA

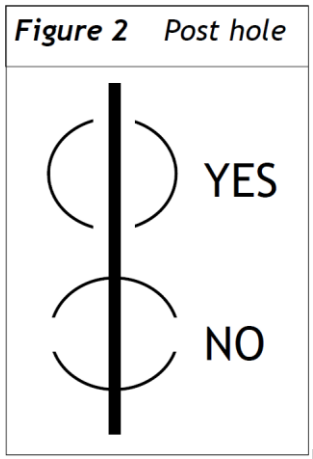


Utility Tolerance Zone

- When digging in Tolerance Zone:
- Hand dig only with shovels or post hole diggers
- Avoid use of picks or mattocks
- Keep face of shovel toward side of facility fig.1
- Post hold diggers, keep blade opening going same direction as facility fig. 2

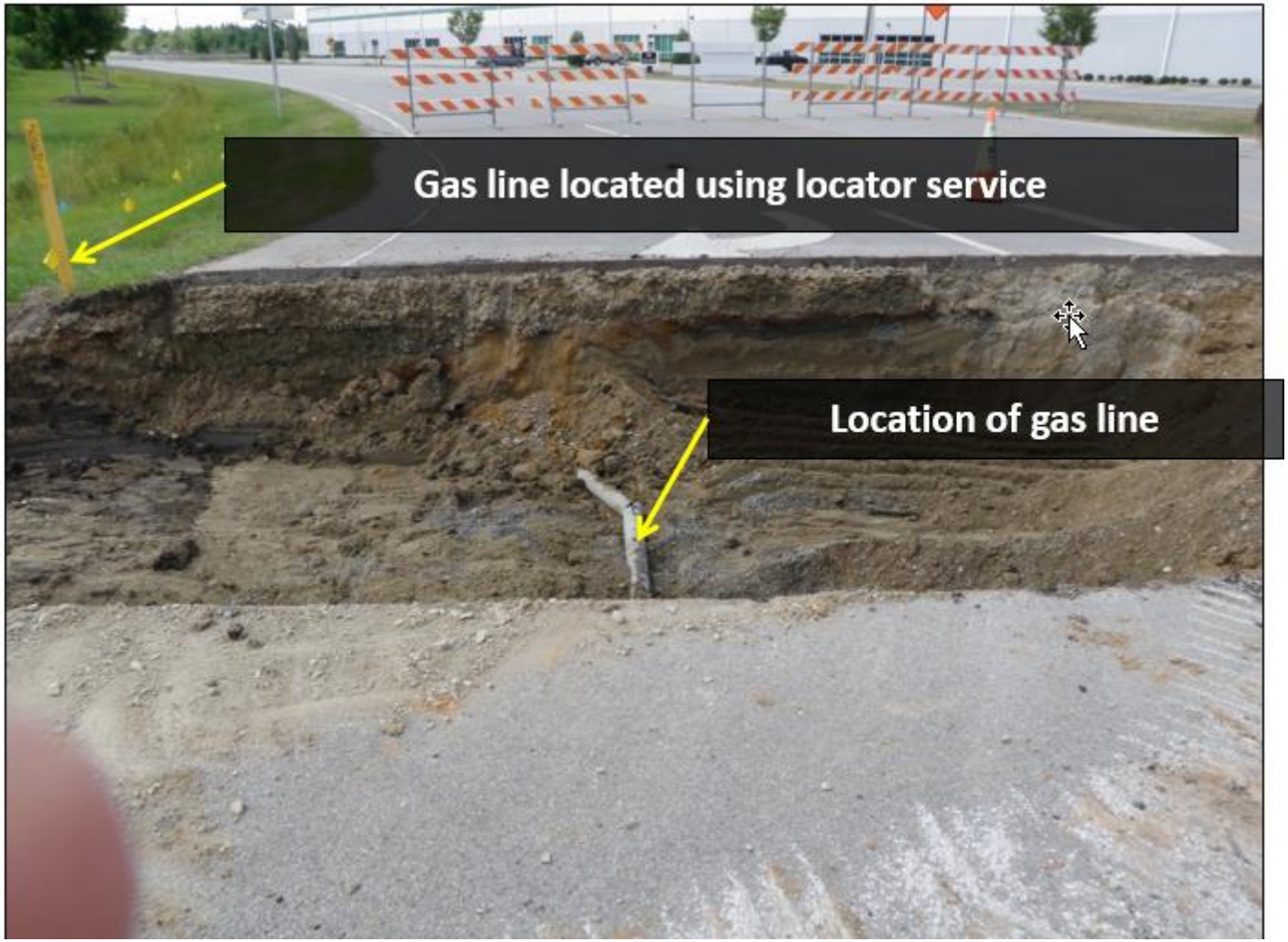






Tolerance Zone Video

Dig With Caution



Surface Encumbrances

- All surface encumbrances that are located so as to create a hazard to employees shall be removed or supported, as necessary, to safeguard employees.
  - Gas Lines
  - Water/Sewer Lines
  - Phone Lines
  - Power Poles
  - Fiber Optic Cables
  - Sidewalks & Curbs
  - Adjacent structures

What to do with Underground Utilities

- While the excavation is open, underground installations shall be:
  - Protected
  - Supported
  - Removed

Utility Lines in an Excavation

Utility Strike?

Means of Entry and Egress

- A stairway, ladder, ramp or other safe means of egress shall be located in trench excavations that are ***4 feet*** or more in depth so as to require no more than ***25 feet*** of lateral travel for employees.

Exposure to Vehicular Traffic

- Employees exposed to public vehicular traffic shall be provided with, and shall wear, warning vests or other suitable garments marked with or made of reflectorized or high-visibility material.
  - Vest – ANSI Class II
  - Flaggers – orange hat

Exposure to Falling Loads

- No employee shall be permitted underneath loads handled by lifting or digging equipment.

Falling Loads – Loading & Unloading Vehicles

- Employees shall be required to stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials.

- Operators may remain in the cabs of vehicles being loaded or unloaded when the "vehicles are equipped to provide adequate protection" for the operator during loading and unloading operations.

Warning System for Mobile Equipment

- When mobile equipment is operated adjacent to an excavation, or when such equipment is required to approach the edge of an excavation, and the operator does not have a clear and direct view of the edge of the excavation, a warning system shall be utilized such as:
    - barricades;
    - hand or mechanical signals;
    - stop logs;
    - If possible, the grade should be away from the excavation.

No Warning System

No Warning System

Hazardous Atmospheres

- Hazardous Atmospheres in excavations could be caused by:
  - Volatile Organic Compounds
  - Methane
  - Gas Powered Hand Tools (Carbon Monoxide)
  - Vehicle and Equipment Exhaust (Carbon Monoxide)
  - Natural Gas Lines
  - Sewer Lines (Hydrogen Sulfide)
  - Chemicals
  - Flammables and Combustibles

Hazardous Atmosphere

- Where oxygen deficiency or a hazardous atmosphere exists or could reasonably be expected, the atmosphere in the excavation **shall be tested before employees enter excavations**.
- Safeguards shall be taken to prevent employee exposure to atmospheres containing less than 19.5 percent oxygen and other hazardous atmospheres.
- These precautions include providing proper respiratory protection or ventilation.

Hazardous Atmospheres

- Safeguards shall be taken such as providing ventilation, to prevent employee exposure to an atmosphere containing a concentration of a flammable gas in excess of ***20 percent*** of the ***lower flammable limit*** of the gas.

- When controls are used that are intended to reduce the level of atmospheric contaminants to acceptable levels, testing shall be conducted as often as necessary to ensure that the atmosphere remains safe.

Hazardous Atmospheres

- What do you use to determine oxygen level in an excavation?
- Where is your meter located?
- What does it test for?
- When was it last calibrated?
- Does the person operating it know the proper operation procedures and how to manipulate the meter?

Emergency Rescue Equipment

- Emergency rescue equipment, such as breathing apparatus, a safety harness and line, or a basket stretcher, shall be readily available where hazardous atmospheric conditions exist or may reasonably be expected to develop during work in an excavation. This equipment shall be attended when in use.

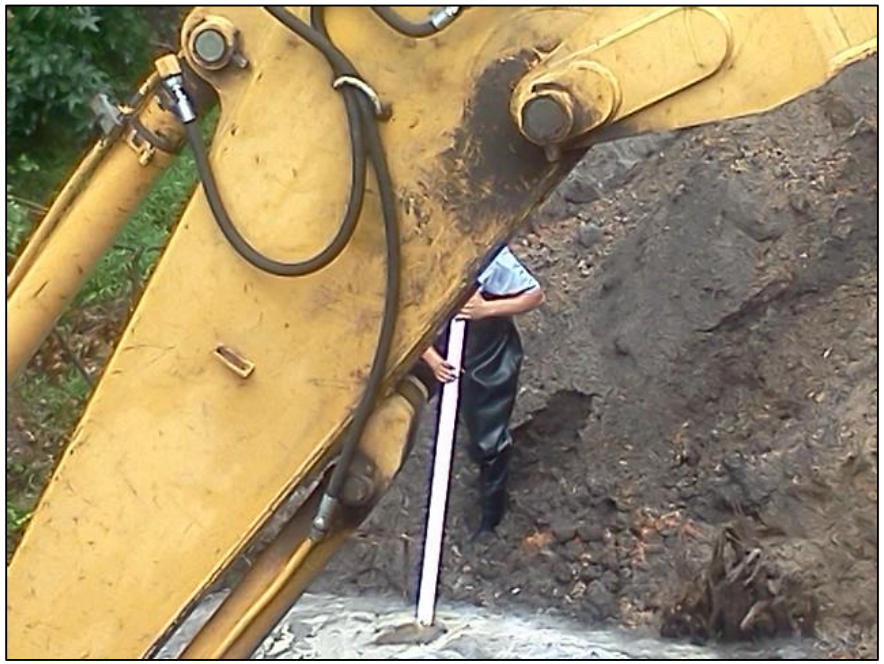
Water Hazard

- Employees shall not work in excavations in which there is accumulated or accumulating water unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation.

- The precautions necessary to protect employees adequately vary with each situation, but could include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and lifeline.

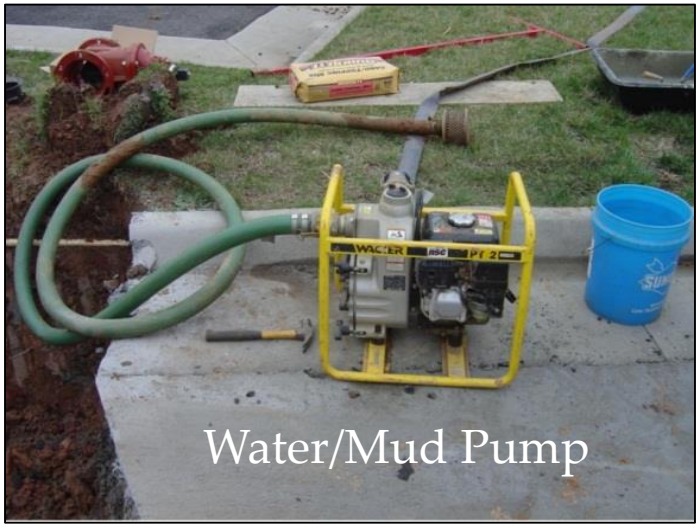
Water in Excavations

Water in Excavations



Water Hazard

- A competent person will oversee the control or prevention of water accumulation, water removal equipment and operations.



Aqua-Dam and Well Points

Stability of Adjacent Structures

- Sidewalks, pavements and appurtenant structure shall not be undermined unless a support system or another method of protection is provided to protect employees from the possible collapse of such structures.

Is that pole stable?

Adjacent Structures

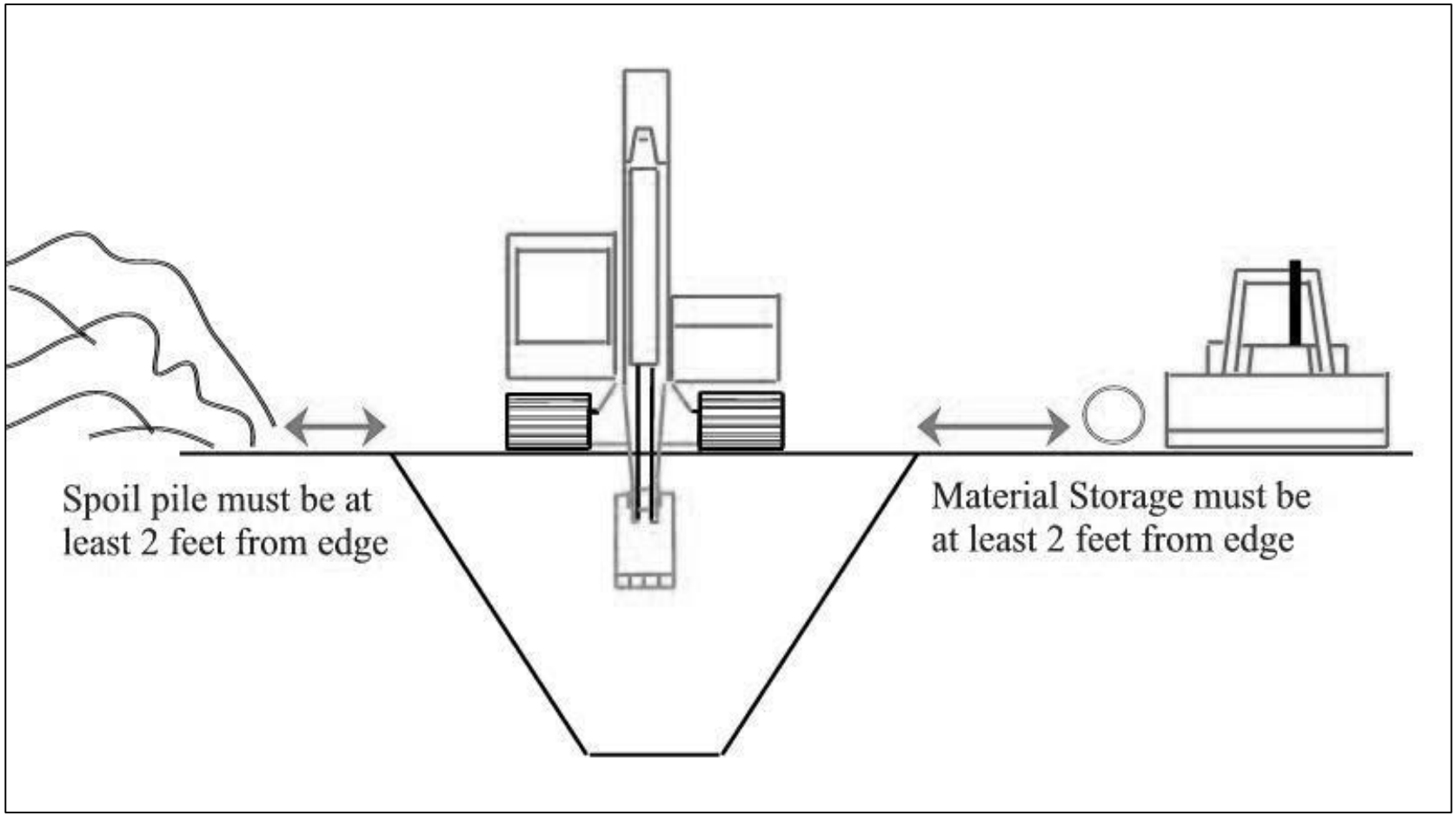
Would you feel safe with your daughter working there?

Protection From Loose Rock or Soil

- Protect employees from loose rock or soil that could pose a hazard by falling or rolling from an excavation face.
  - scaling to remove loose material
  - installation of protective barricades at intervals as necessary on the face to stop and contain falling material
  - or other means that provide equivalent protection
  - hard hats

- Employees shall be protected from excavated or other materials or equipment that could pose a hazard by falling or rolling into excavations.
  - protection shall be provided by placing and keeping such materials or equipment at least 2 feet from the edge of excavation
  - or by the use of retaining devices that are sufficient to prevent materials or equipment from falling or rolling into excavations
  - or by a combination of both if necessary.

Spoil Piles & Material Storage



Fall Protection & Excavations

- 1926.501(b)(7) (i) Each employee at the edge of an excavation 6 feet or more in depth shall be protected from falling by guardrail systems, fences, or barricades when the excavations are not readily seen because of plant growth or other visual barrier;

Fall Protection & Excavations

- 1926.501(b)(7)(ii) Each employee at the edge of a well, pit, shaft, and similar excavation 6 feet or more in depth shall be protected from falling by guardrail systems, fences, barricades, or covers.

Fall Protection

- Walkways shall be provided where employees or equipment are required or permitted to cross over excavations.

- Guardrails which comply with fall protection regulations shall be provided where walkways are 6 feet (1.8 m) or more above lower levels.

Excavation Protective Systems

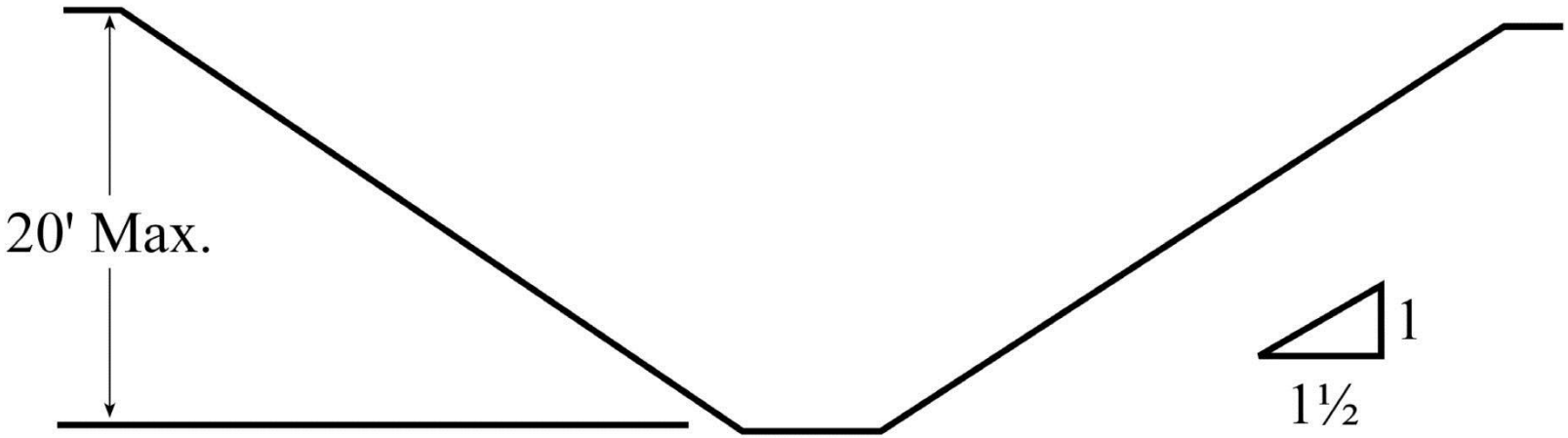
- Each employee in an excavation shall be protected from cave-ins by an adequate protective system except when:
  - Excavations are made entirely in stable rock; or
  - Excavations are less than 5 feet in depth and examination of the ground by a "competent person" provides no indication of a potential cave-in. 1926.652(a)(1)(ii)
- If the excavation is less than 5 feet, a competent person must examine it before workers enter it.

Excavation Protective Systems

Protective systems for excavations:

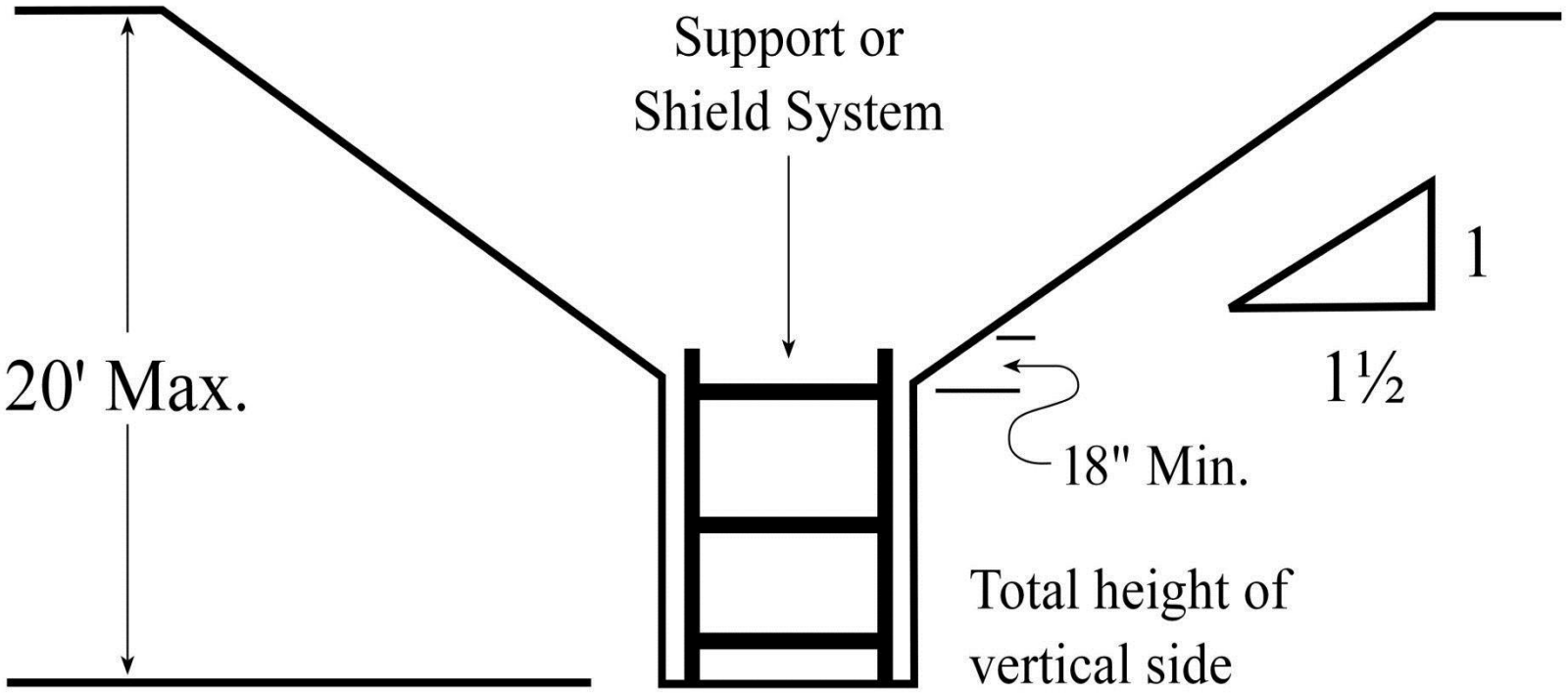
- Sloping the sides of the excavation
- Shoring the sides of the excavation
- Shielding the work area.

Excavations in Type “C” Soil

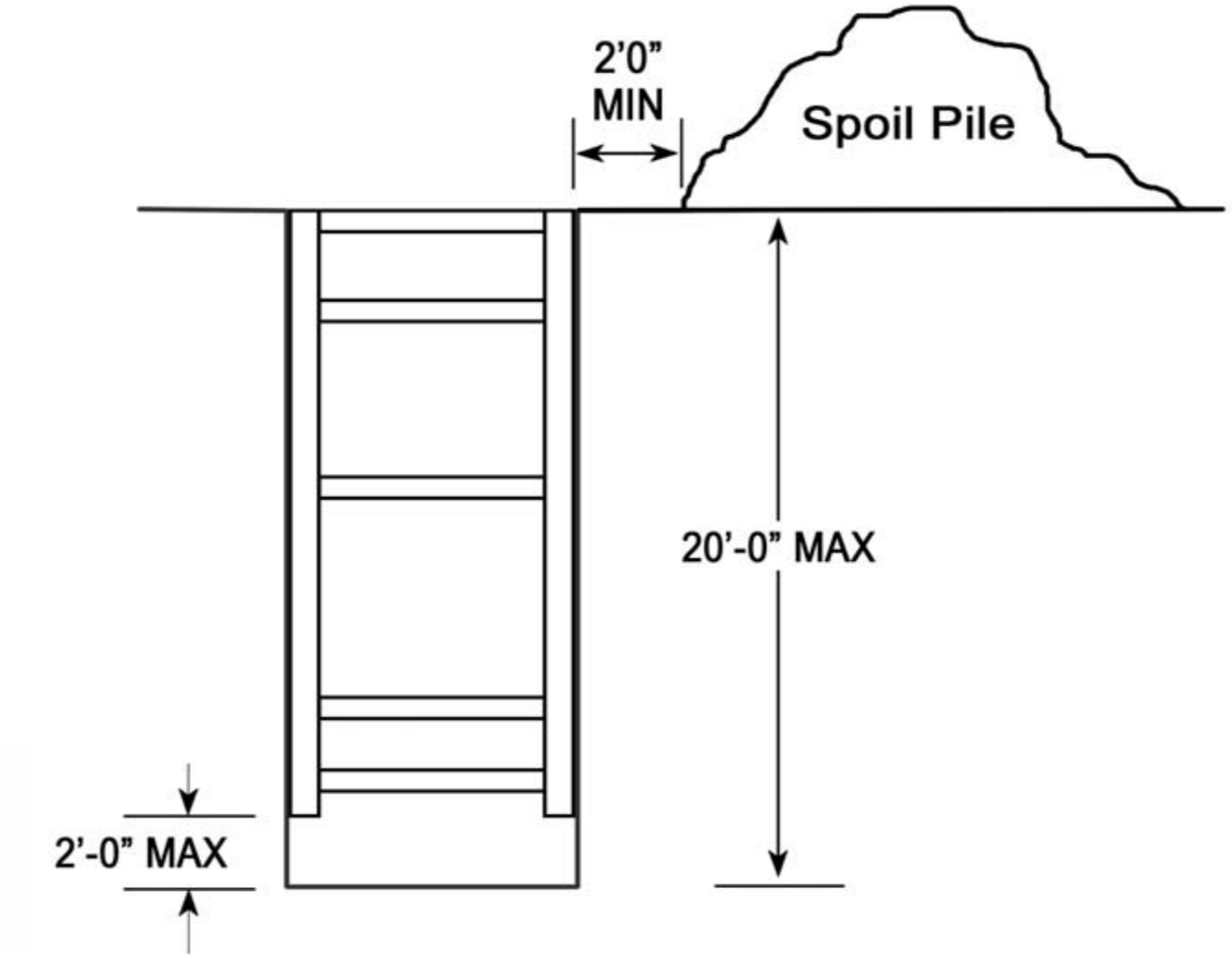


Simple Slope

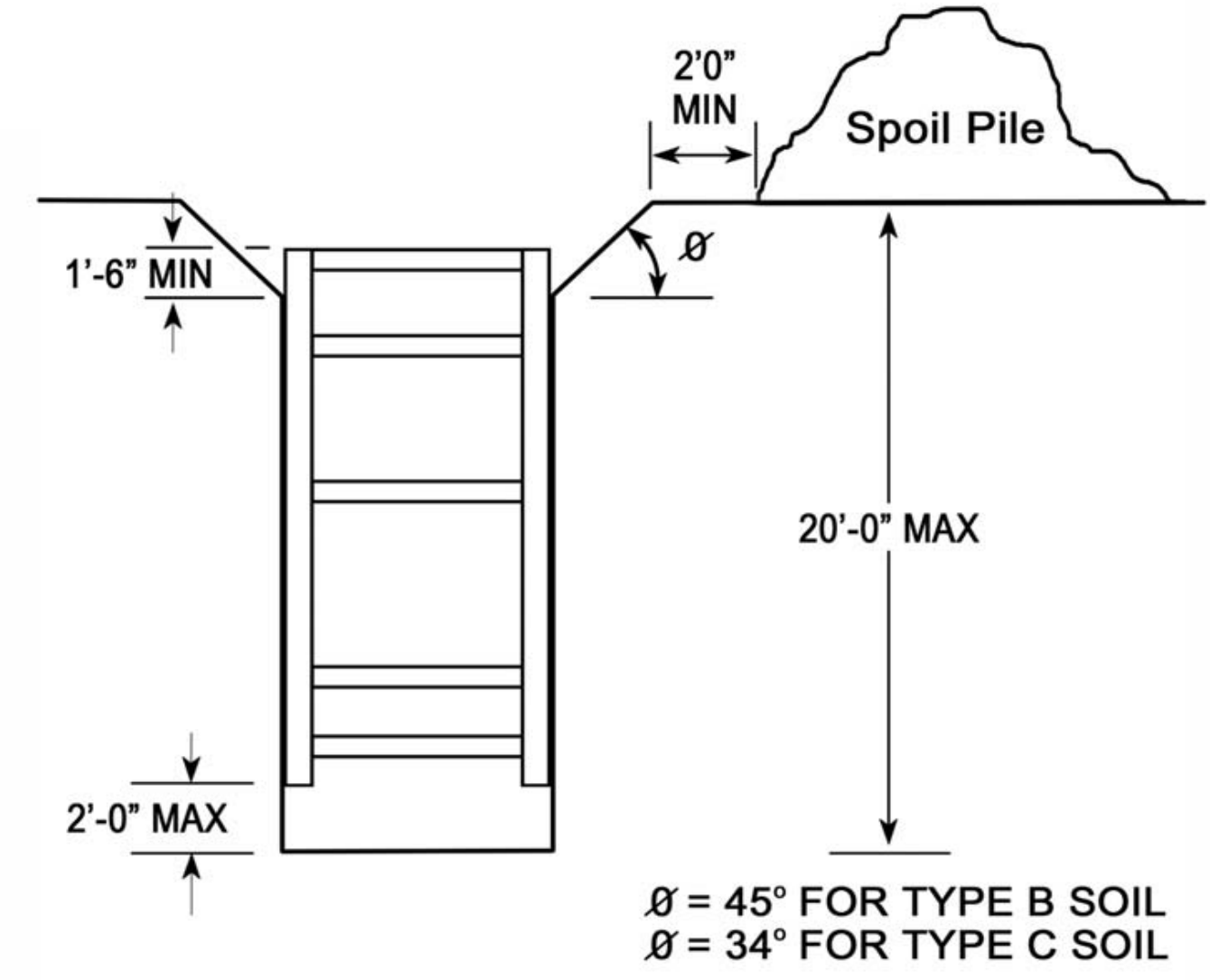
Excavations Made in Type “C” Soil



Shield Installed At Grade



Shield Installed Below Grade



Trench Shield/Box

- Employees shall not be allowed in shields when shields are being installed, removed, or moved vertically.

Trench Shields

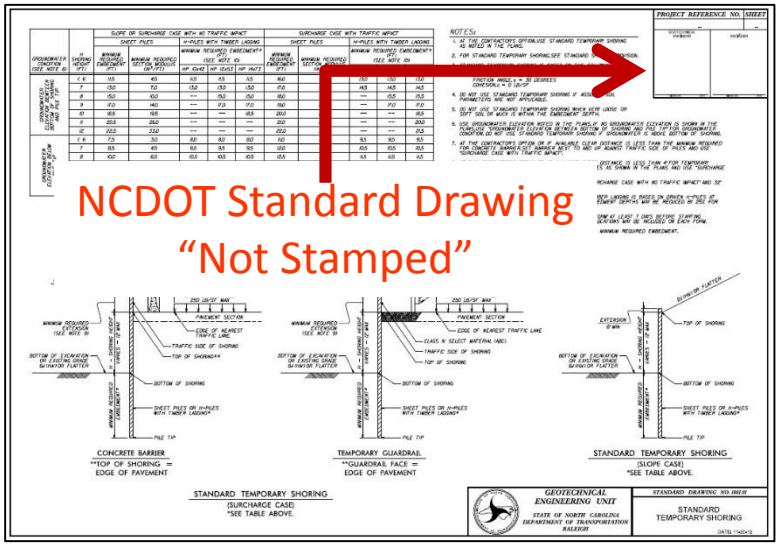
- Shields are manufactured by a number of companies and are designed to protect workers working within the confines of the shield.
- Check tabulated data for the maximum allowable depth it can be used.
- The tabulated data must accompany the shield when it is being used.
- The shield must be designed by a Registered Professional Engineer, be in good condition, and be used per manufacturers recommendation.
  - "You need to have the Manual."

Trench Shield Inspection

- Conducted by the Competent Person.
- Conducted daily, prior to each shift and as needed throughout the shift.
- Conducted after every rainstorm or other hazardous event.
- Two categories of the inspection:
  - Condition of the protective system (Trench Shield/box)
  - Proper installation of the protective system

Sheet-Piles as a Protective System

- The use of sheet-piles in NCDOT must be designed and stamped by a registered professional engineer.
- Please consult with the Area Geotechnical Operations Engineers before using sheet-piles as a protective system.



Inspections

- All excavations & protective equipment must be inspected on a daily basis by a competent person:
  - Daily and before the start of each shift;
  - As dictated by the work being done in the trench;
  - After every rainstorm;
  - After other events that could increase hazards, e.g. snowstorm, windstorm, thaw, earthquake, etc.;
  - When fissures, tension cracks, sloughing, undercutting, water seepage, bulging at the bottom, or other similar conditions occur;
  - When there is a change in the size, location, or placement of the spoil pile; and
  - When there is any indication of change or movement in adjacent structures.

Supervisor Excavation Checklist

- Employees prohibited from working on faces of sloped or benched excavations above other employees.
- Warning system established and used when mobile equipment is operating near edge of excavation.
- Utility companies contacted and/or utilities located.
- Exact location of utilities marked when near excavation.
- Underground installations protected, supported, or removed when excavation is open.
- Precautions taken to protect employees from accumulation of water.

Supervisor Excavation Checklist

- Water removal equipment monitored by Competent Person.
- Surface water controlled or diverted.
- Inspection made after each rainstorm.
- Atmosphere tested when there is a possibility of oxygen deficiency or build-up of hazardous gases.
- Oxygen content is between 19.5% and 21%.
- Ventilation provided to prevent flammable gas build-up to 20% of lower explosive limit of the gas.

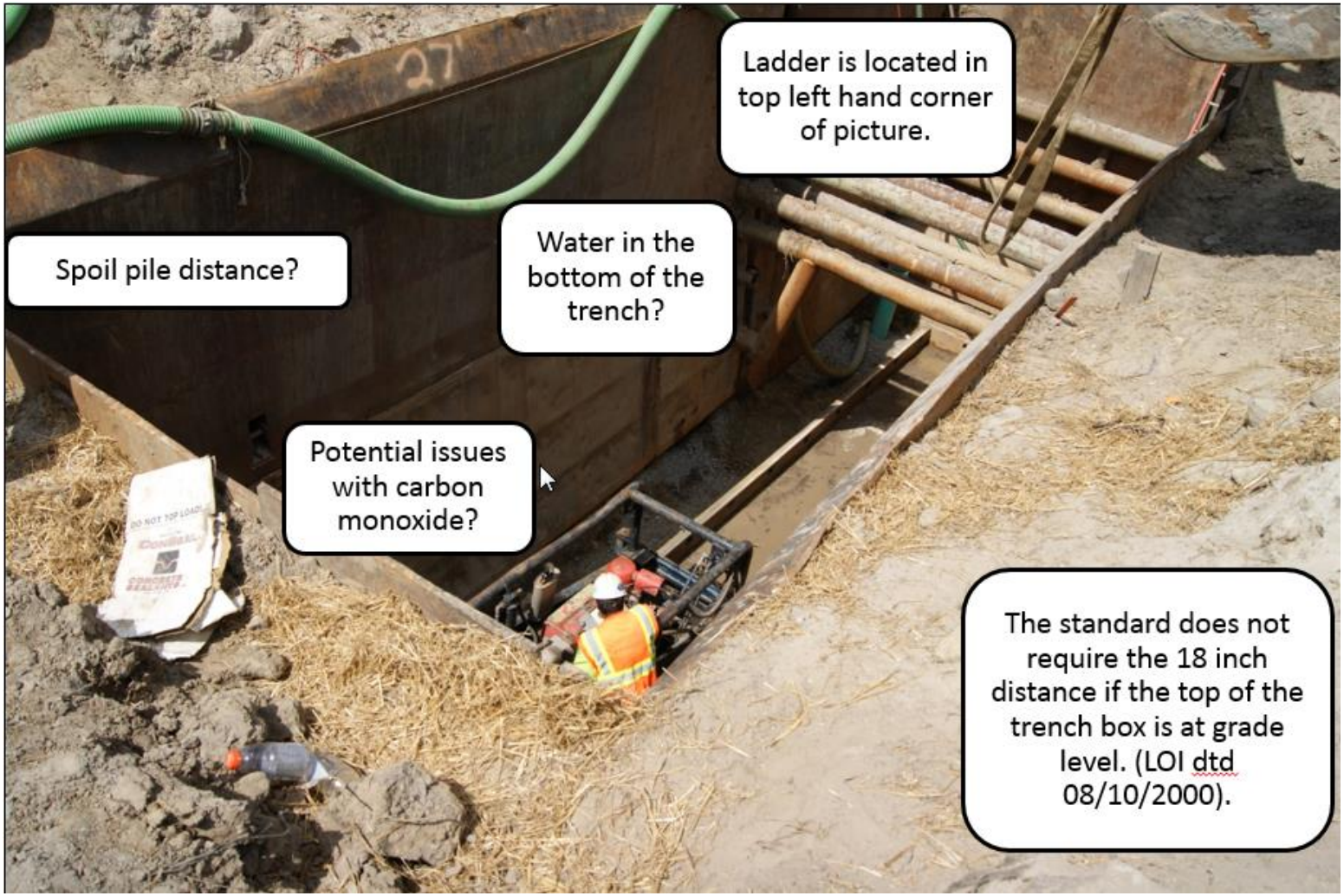
Supervisor Excavation Checklist

- Testing conducted to ensure that atmosphere remains safe.
- Emergency Response Equipment readily available where a hazardous atmosphere could or does exist.
- Employees trained in the use of Personal Protective and Emergency Response Equipment.
- Safety harness and life line individually attended when employees enter deep confined excavation.

Supervisor Hazard Recognition

What are the Hazards?

Supervisor Observations



What are the Hazards?

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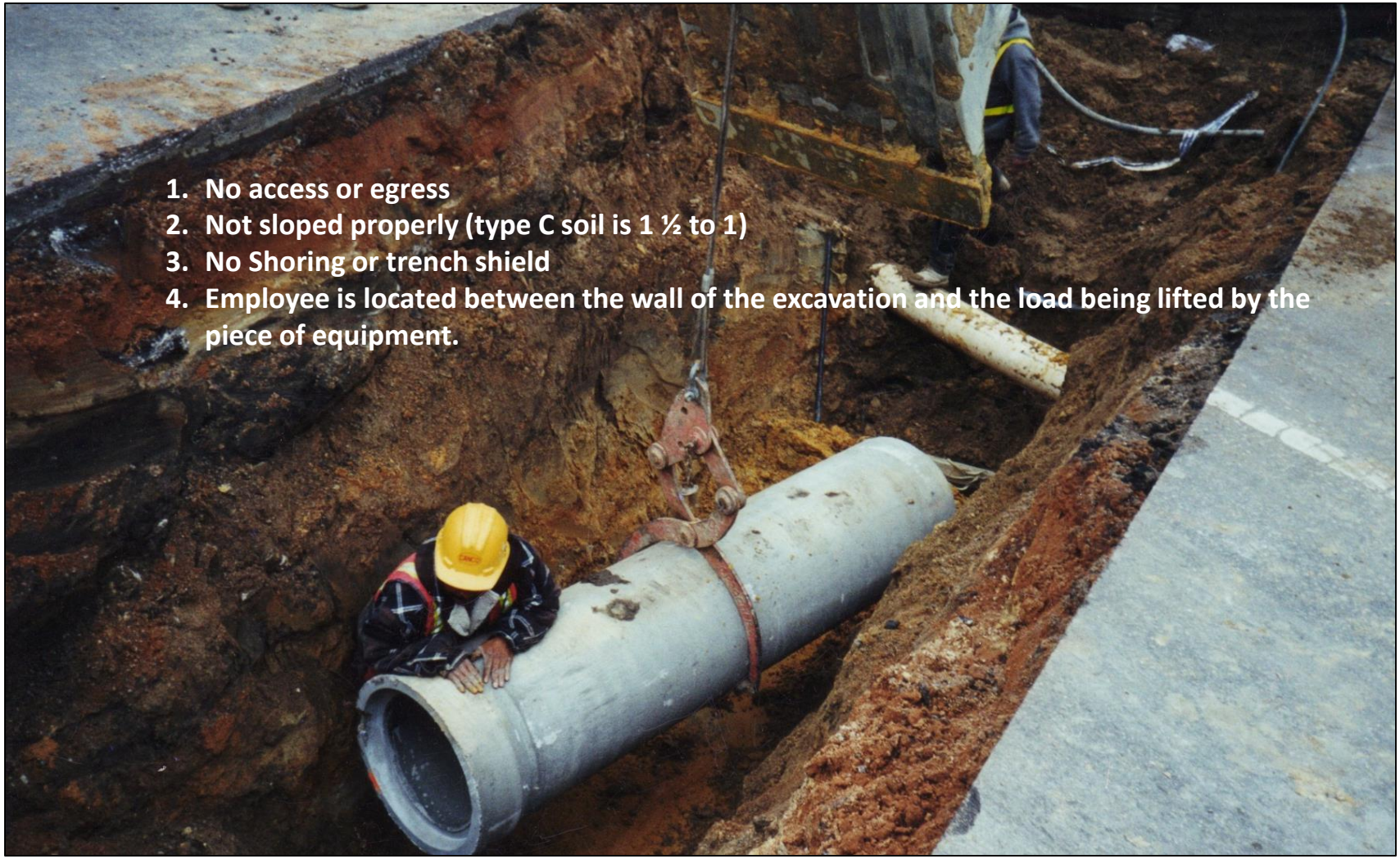


Are They At Risk?

Access & Egress?

- Good thing he's holding the ladder securely in place!

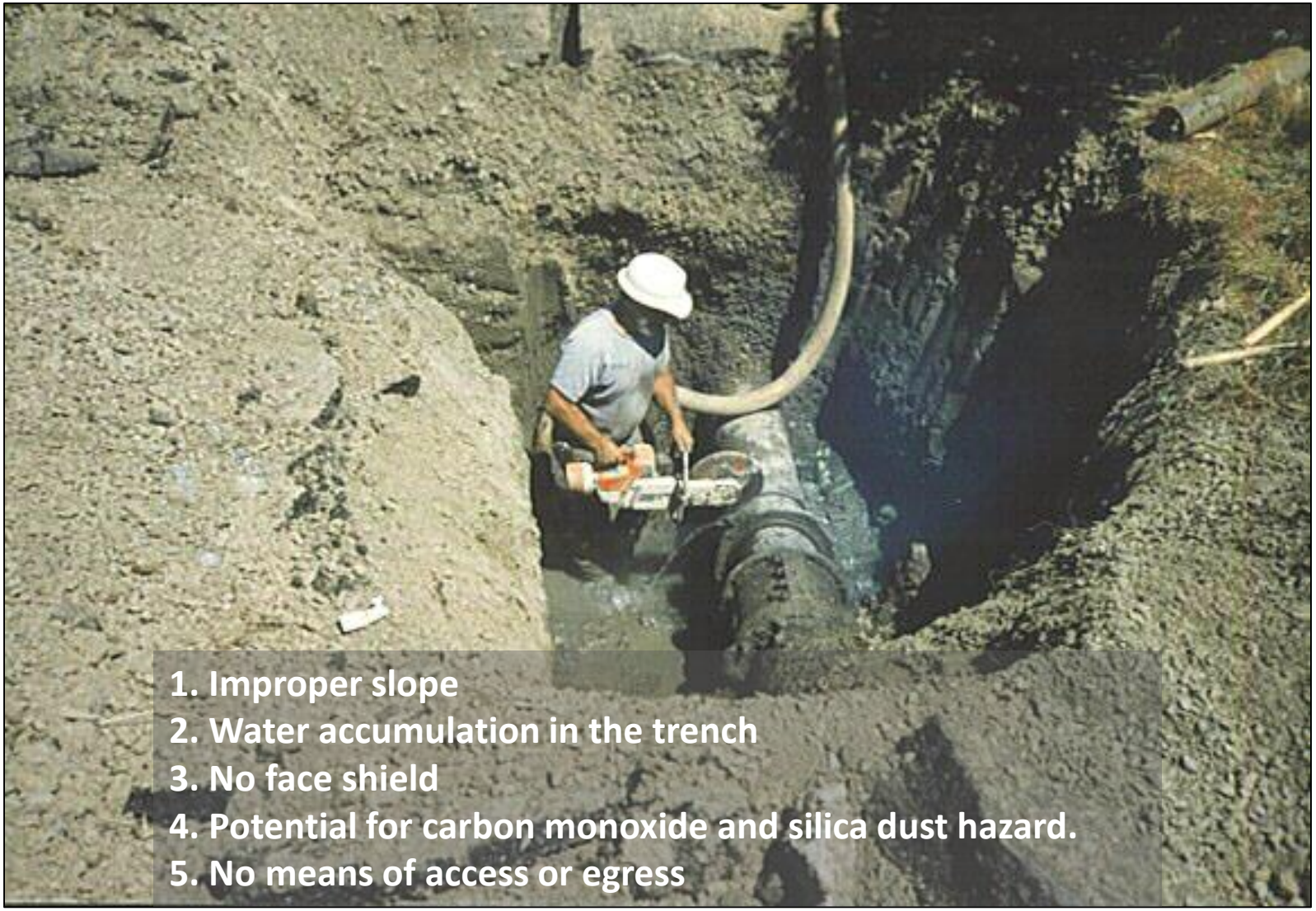
What Are The Hazards?

Hazards?

What are the Hazards?

- Depth – slope
- Carbon Monoxide
- Ladder
- Gas can

What are the Hazards?



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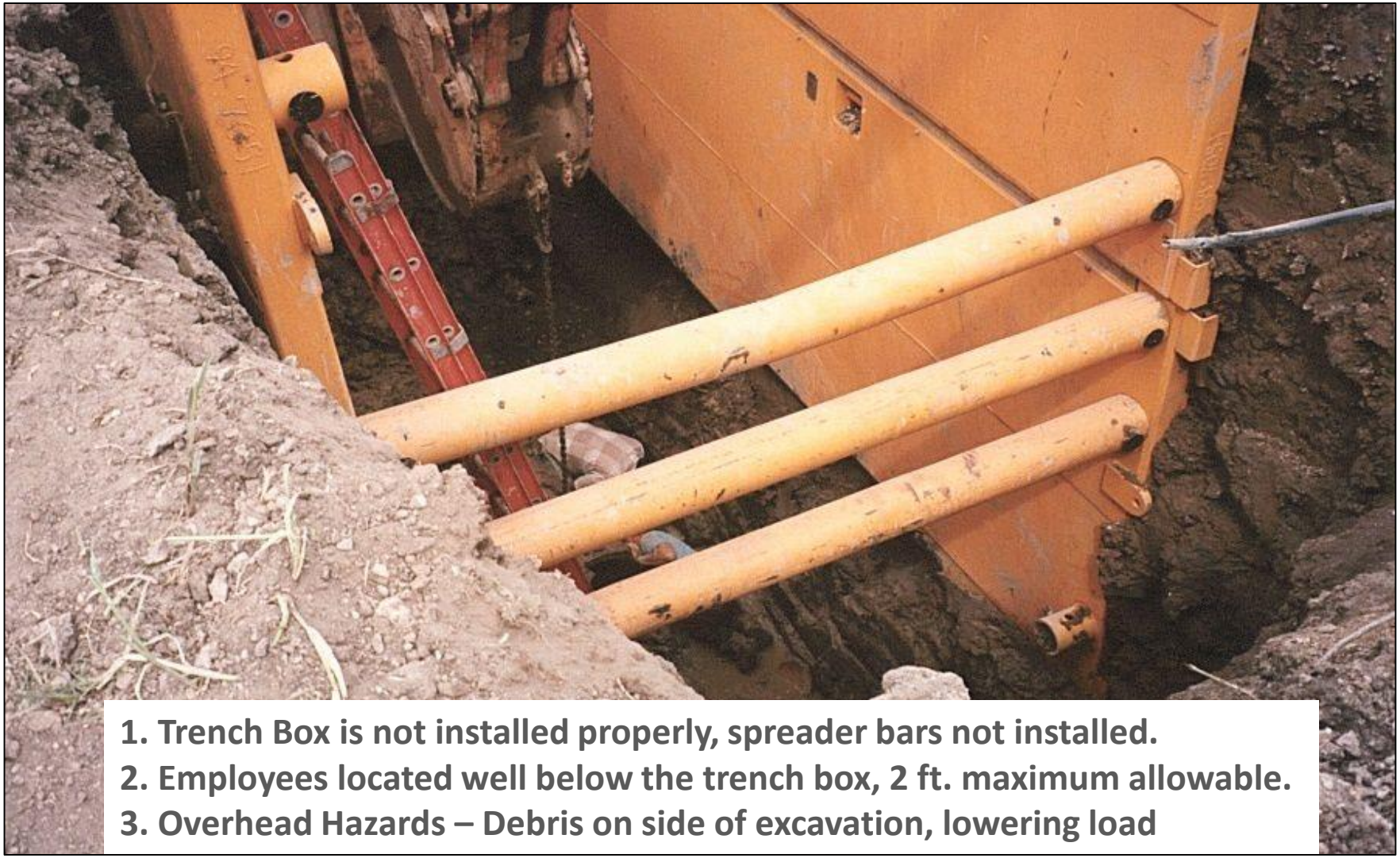

1. Trench Box is not installed properly, spreader bars not installed.
2. Employees located well below the trench box, 2 ft. maximum allowable.
3. Overhead Hazards – Debris on side of excavation, lowering load

What are the Hazards?

1. Slope – Is it cut back far enough? Trench Box?
2. Depth - Means of Access and Egress?
3. Vehicular Traffic – Are protections in place for the workers?
4. Competent Person onsite?

You're the Supervisor!

- Trench Box Installation
- Means of Access and Egress
- Spoil Pile back 2 feet?
- Depth of trench box in relation to side walls of excavation
- Trench box stability

Trench Supervisor

- This presentation is designed to touch on a few excavation safety areas.
- For additional training on safe excavation operations, consult with your safety professional.